Electronic Version
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Claims

[c1] 1.A voltage sensor circuit comprising:

a source-input node having a source-input voltage that is varied by a voltage source, the voltage sensor circuit sensing the source-input voltage of the source-input node;

a stable node having a stable voltage that is relatively insensitive to changes in a supply voltage;

a first current source, responsive to the source-input voltage, for generating a first current that varies with variations in the source-input voltage;

a first resistor, coupled to the first current source and receiving the first current, for generating a compare-input voltage on a compare-input node in response to the first current, the compare-input voltage varying with variations in the first current;

a second current source for generating a second current that is insensitive to variations in the source-input voltage;

a second resistor, coupled to the second current source and receiving the second current, for generating a reference voltage on a reference node in response to the second current, the reference voltage not varying with vari-

ations in the second current; and

a comparator coupled to the compare-input node and the reference node, for comparing the compare-input voltage to the reference voltage and generating an output voltage at an output node that indicates when the compare-input voltage is above the reference voltage.

[c2] 2.The voltage sensor circuit of claim 1 wherein the first current source is a substrate-sensing transistor having a substrate node driven by the source-input voltage and a gate driven by a constant bias voltage, the substrate-sensing transistor conducting the first current between the stable node and the compare-input node,

wherein the first current through the substrate-sensing transistor varies with variations in the source-input voltage,

whereby a substrate-sensing current source generates the first current.

[c3] 3.The voltage sensor circuit of claim 2 wherein the substrate-sensing transistor is a p-channel transistor and the substrate node is an N-well.

[c4] 4.The voltage sensor circuit of claim 3 wherein the constant bias voltage is a ground.

[c5] 5.The voltage sensor circuit of claim 4 wherein the sec-

ond current source is a second p-channel transistor having a substrate node connected to the stable node and a gate driven by the constant bias voltage, the second p-channel transistor conducting the second current between the stable node and the reference node.

[c6] 6.The voltage sensor circuit of claim 5 wherein a cross-over voltage of the source-input voltage that causes the output voltage to change states varies less than +/- 8% over a temperature range from -40 to +85 degrees C.

[c7] 7.The voltage sensor circuit of claim 1 wherein the first current source comprises:
a first mirror transistor having a channel that conducts the first current between the stable node and the compare-input node in response to a first gate node;
a first setting transistor, with a gate connected to the first gate node, having a channel that conducts a first setting current between the stable node and the first gate node;
a first sensing transistor having a channel that conducts a portion of the first setting current from the first gate node, the first sensing transistor having a gate connected to the source-input voltage;
wherein the second current source comprises:
a second mirror transistor having a channel that conducts the second current between the stable node and

the reference node in response to a second gate node;
a second setting transistor, with a gate connected to the second gate node, having a channel that conducts a second setting current between the stable node and the second gate node; and
a second sensing transistor having a channel that conducts a portion of the second setting current from the second gate node, the second sensing transistor having a gate connected to a fixed voltage.

[c8] 8.The voltage sensor circuit of claim 7 wherein the fixed voltage applied to the gate of the second sensing transistor is the stable voltage.

[c9] 9.The voltage sensor circuit of claim 8 wherein the first and second mirror transistors and the first and second setting transistors are p-channel transistors;
wherein the first and second sensing transistors are n-channel transistors.

[c10] 10.The voltage sensor circuit of claim 9 wherein a cross-over voltage of the source-input voltage that causes the output voltage to change states varies less than +/- 4% over a temperature range from -40 to +85 degrees C.

[c11] 11.The voltage sensor circuit of claim 7 further comprising:

a voltage generator for generating the stable voltage on the stable node that is independent of a supply voltage to the comparator.

[c12] 12.The voltage sensor circuit of claim 11 wherein the voltage generator is a band-gap voltage generator.

[c13] 13.The voltage sensor circuit of claim 12 wherein the comparator is powered by the supply voltage.

[c14] 14.A substrate-sensing voltage sensor comprising:
a voltage generator for generating a stable voltage on a stable node, the stable voltage being relatively insensitive to variations in a supply voltage;
a comparator that generates an output by comparing voltages of a compare-input node and a reference node;
a first transistor having a channel connected between the stable node and the compare-input node, with a gate connected to a bias voltage and a substrate connected to a source-input voltage that is varied by a voltage source;
a first resistor connected between the compare-input node and a ground;
a second transistor having a channel connected between the stable node and the reference node, with a gate connected to the bias voltage; and
a second resistor connected between the reference node and the ground,

whereby the source-input voltage from the voltage source is sensed by substrate-sensing of the first transistor.

[c15] 15.The substrate-sensing voltage sensor of claim 14 wherein the first transistor is a p-channel transistor with a source connected to the stable node, a drain connected to the compare-input node, and the source-input voltage connected to a n-type substrate or an N-well under the first transistor;
wherein the second transistor is a p-channel transistor with a source connected to the stable node, a drain connected to the reference node, and the stable voltage connected to a n-type substrate or an N-well under the second transistor.

[c16] 16.The substrate-sensing voltage sensor of claim 15 wherein the bias voltage is the ground,
whereby the first and second transistors have grounded gates.

[c17] 17.A temperature-insensitive voltage sensor comprising:
an input voltage from a varying voltage source;
compare means, having a first input and a second input, for comparing voltages on the first and second inputs to generate an output;
first resistor means, receiving a first current, for gener-

ating a compare voltage on the first input of the compare means;

first mirror transistor means, having a gate connected to a first gate node, for generating the first current from a stable node to the first input of the compare means and to the first resistor means;

first current-source transistor means, having a gate and a drain connected to the first gate node and a source connected to the stable node, for generating a first gate voltage on the first gate node;

first sensing transistor means, having a gate driven by the input voltage, for varying a first sink current from the first gate node in response to the input voltage;

second resistor means, receiving a second current, for generating a reference voltage on the second input of the compare means;

second mirror transistor means, having a gate connected to a second gate node, for generating the second current from the stable node to the second input of the compare means and to the second resistor means;

second current-source transistor means, having a gate and a drain connected to the second gate node and a source connected to the stable node, for generating a second gate voltage on the second gate node; and

second sensing transistor means, having a gate driven by a constant voltage, for generating a second sink current

from the second gate node,
whereby variations in the first current due to temperature variations are compensated by variations in the second current that are due to the temperature variations.

[c18] 18.The temperature-insensitive voltage sensor of claim 17 further comprising:
stable-voltage generator means for generating a stable voltage on the stable node, the stable voltage being insensitive to a supply voltage to the compare means.

[c19] 19.The temperature-insensitive voltage sensor of claim 18 wherein the first and second sensing transistor means are n-channel transistors having grounded sources;
wherein the first and second mirror transistor means are p-channel transistors having sources connected to the stable node;
wherein the first and second current-source transistor means are p-channel transistors having sources connected to the stable node and each having a drain shorted to a gate.

[c20] 20.The temperature-insensitive voltage sensor of claim 19 wherein the constant voltage to the gate of the second sensing transistor means is a the stable voltage.